

## **PI.7 Development of a Fast-Response Isotopic Air Monitor**

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### **Abstract**

The U.S. Department of Energy (DOE) must ensure that on-site worker health and safety is not compromised by airborne radioactive contamination. In addition, the DOE must ensure that effluent air and gas streams leaving DOE sites and waste treatment facilities do not negatively impact public safety or health. Alpha-emitting radioisotopes, such as U-238/U-234 and Pu-239, are rated by the U.S. Environmental Protection Agency (EPA) as class A carcinogens. Alpha-emitting radioisotopes have very low regulated upper limits in air and process gas streams. Uranium also has a high chemical toxicity. The development of improved airborne alpha monitoring technology ranks as one of the top priorities of the DOE Decontamination and Decommissioning (D&D) Focus Area, based on the five needs currently listed by various DOE Site Technology Coordinating Groups.

To meet this D&D need, Thermo Power Corporation is developing and testing a novel Continuous Air Monitor (CAM) for monitoring alpha-emitting radionuclides. This CAM technology can also be applied to Continuous Emission Monitoring (CEM) of thermal treatment system off-gas streams. The CAM instrument will have very high alpha spectral resolution and provide real-time, on-line monitoring suitable for alerting workers of high concentrations of alpha-emitting radionuclides in the ambient air and for improved control of decontamination, dismantlement, and air emission control equipment. In addition to being very cost-effective, the instrument will greatly improve data reliability by eliminating the self-shielding associated with filter-based assay instruments, and excellent isotopic resolution will permit operation in areas with high background radon levels.

The technology involves a proprietary, patent-pending method of collecting and measuring airborne radioactive species. Employing a novel integration of technologies, it first accumulates and preconcentrates radioactive airborne or gasborne particulates from a very large sample volume by electrostatic precipitation onto a slowly-moving non-porous film. This allows for rapid quantification of the specific alpha-emitting species using high-resolution solid-state silicon detectors. This technique has isotopically quantified 0.02 pCi/l radon and thoron progeny in ambient air in a 10 minute sample/count cycle, a sensitivity beyond the required 0.002 pCi/l of Pu-239 (1 DAC) in 8 hours prescribed by DOE in 10CFR835. The used film can be archived to meet DOE requirements.

In addition to being applied to Continuous Emission Monitoring (CEM) of alpha emitters in thermal treatment system off gas streams, this new method can be modified to incorporate air or off gas analysis by conventional methods (i.e., x-ray fluorescence, laser-induced fluorescence, particle size distribution, etc.) Furthermore, a two-stage version of this device would go beyond the sensitivity required for implementing the Comprehensive Test Ban Treaty (CTBT), and allow the U.S. to meet future monitoring challenges (such as the proposed Fissile Materials Cutoff Treaty and the International Atomic Energy Agency's (IAEA) Strengthened Safeguards System.)

Ongoing Phase I work has involved developing and testing a laboratory prototype CAM. This prototype CAM has been well characterized, including measuring its performance for over four hours of continuous operation. The design of a future 19" rack-mounted instrument is underway. Plans are being made to perform the upcoming Phase II field test of the instrument at the Los Alamos National Laboratory storage and disposal area, TA-54. An independent Phase II performance test of the instrument using characterized plutonium aerosols will be conducted at the Lovelace Respiratory Research Institute. Future manufacturing plans for deployment of the instrument are being addressed.

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